Institutional Aspects of the Hydrological Warning System in the Del Plata Basin

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The National Water Institute (INA), a decentralized agency of the Sub-secretariat of Water Resources, is responsible for the development and operation of the Hydrologic Information and Warning System for the Del Plata Basin in Argentina.

The Del Plata basin is one of the largest watersheds in South America (second after the Amazonia) and in the world. With an area of more than three million square kilometers, it is shared by five countries: Brazil, Paraguay, Bolivia, Uruguay and Argentina (the most downstream country of the five). Population (more than a hundred million inhabitants), economic development (it contributes with an eighty percent of the combined gross product of all five countries), hydropower generation (about sixty hydropower plants), navigability of its rivers, and extensive agricultural, cattle raising and forestry activities account for its relevance.
Its main rivers are some of the largest in the world and their floods can have a tremendous socio-economic impact, as observed along the history.

This Hydrological Warning System was originated after the devastating floods of 1982-83 and has been providing a permanent service ever since. Through data reception, analysis and transmission, this service is devoted to deal with operational hydrometeorology, basin monitoring, and short-, medium and long-term hydrological forecasts.

Given the nature of its activities, permanent contact is kept with the people affected by the presence of the rivers. In the twenty three years this System has been operating, different emergencies have been faced, not only big floods but long droughts as well. Also droughts have a major impact, affecting severely the economy of the riparian zone. Apart from the obvious impact on the agriculture, many other activities are impaired, such as port operation, barge convoy operation, fleet, intakes for drinking water, tourism, etc.

Through time, consolidation of the system was achieved by improving data collection, diagnosis and forecast processes and by strengthening the relation with the users. In this regard, the approach adopted is that of rendering a service based on the participation of both information providers and information users, holding the concept of an *end-to-end* process, in which the Warning System is positioned halfway.

In the case of floods, an early warning service must communicate the potential occurrence of extraordinary hydro-meteorological events to civil protection agencies and disaster control authorities. The accuracy of the forecasts is a major concern since an underestimation of the predicted stages can lead to disastrous inundations while, conversely, an overestimation can lead to unnecessary expenses and an inadmissible loss of reliability for future events. The accuracy and regularity of the forecasts contribute substantively to preservation of life and minimization of losses of goods and infrastructure. There must be a full awareness of this statement among the main actors of the process.

This commitment requires a continuous development of methodologies, models and institutional agreements in close cooperation with the relevant actors. Performing a permanent hydrologic surveillance of basin conditions and forecasting potential floods and droughts implies collecting, processing, and transmitting real-time information. For this purpose, different tasks are carried out, such as:

- Meteorological, hydrometric and field data reception: Data furnished by the other four countries in the basin, by bi-national hydropower operators, and by national and provincial agencies are gathered.
- Database development and update: Data are consisted and loaded into databases.
- Hydrologic and hydraulic modeling: Different models are calibrated and operated for river-stage and discharge forecasting.
- Data processing and GIS applications: Data are digitized and loaded into a Geographic Information System. The topography of the alluvial valley is surveyed and digitized for use in the forecasting of inundation extent.
- Satellite image processing: Remotely-sensed image analysis is used for map generation, showing the spatial distribution of water bodies and moisture. Continuous evaluation is useful for monitoring, prevention, mitigation and disaster management for both floods and droughts. Regional-vulnerability map analysis are also done. Satellite images have been intensively applied for an accurate determination of the extension of the flooded area across alluvial valleys and for delimitation of areas affected with water deficit during droughts.
- Permanent forecasting and hydrologic warning service: As a result of the previous tasks, forecast issuing is possible. The forecasts are then disseminated to decision-making agencies who take non-structural measures in order to mitigate the catastrophe. In normal conditions, the System contributes to a better use of water.

The lessons learned after almost a quarter of a century of uninterrupted operation may be summarized into two concepts:

- The catastrophic water phenomena are highly complex regarding their genesis. Nature is very complex and unpredictable. To anticipate extraordinary events it is necessary not to limit oneself to results of models since they are able to simulate, with a certain degree of accuracy, only normal conditions. It has been experienced that only the permanent monitoring and the interdisciplinary work are the basis to face extreme events, focusing on the occurrence of singularities.
- For the early warning of an extreme event it is necessary to capitalize the experience acquired in previous events. Increasing the awareness of threats and risk and carrying out integrated development on a permanent basis are necessary measures.